



DEPARTMENT OF THE NAVY

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IN REPLY REFER TO

10550
J52-6454ZAN

JUN 15 2000

From: Commander, Dahlgren Division, Naval Surface Warfare Center
To: Commander, Naval Ammunition Logistic Center
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Subj: HAZARDS OF ELECTROMAGNETIC RADIATION TO ORDNANCE (HERO)
SAFETY EVALUATION OF AUTOMATED INFORMATION TECHNOLOGY
(AIT) EQUIPMENT

Ref: (a) MIL-STD-461D Requirements for the Control of
Electromagnetic Interference Emissions and
Susceptibility
(b) MIL-STD-462D Measurement of Electromagnetic
Interference Characteristics

Encl: (1) HERO Safety Evaluation Test Results for Automated
Information Technology (AIT) Equipments

1. As requested by NAVSEA/Mr. Ronald Woody, HERO safety evaluation tests were conducted, during the period 7 June through 11 June 1999, on the AIT equipments. The HERO evaluation of the AIT equipments was based on the results of emission tests to the requirements of reference (a) and were accomplished in accordance with the procedures specified in reference (b). As these test and evaluations were intended to determine the potential HERO impact for unintentional radiated emissions from the AIT to affect ordnance, these tests were limited to the Radiated Emissions (RE102) requirements of reference (a). The equipments subjected to the RE102 test were as follows:

a. Zebra PT400 portable bar code label printer S/N 4051527.

b. Monarch Model Number 9490 portable bar code label printer S/N 98103639.

2. During the RE102 tests, it was determined that the radiated emissions from both test units exceeded the RE102 limits of reference (a). However, the HERO evaluation has determined that the relatively low level radiated emissions will not present a hazard to ordnance provided a minimum separation distance of one meter is maintained while the units are operating. Furthermore, the tests indicate that the units should not be operated in the vicinity of sensitive electronic equipments. The RE102 test results, conclusions, and recommendations are presented in enclosure (1).

Subj: HAZARDS OF ELECTROMAGNETIC RADIATION TO ORDNANCE (HERO)
SAFETY EVALUATION OF AUTOMATED INFORMATION TECHNOLOGY
(AIT) EQUIPMENT

3. Please direct any questions or comments to Benton C. Zander,
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By direction

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**HAZARDS OF ELECTROMAGNETIC RADIATION TO ORDNANCE
(HERO) SAFETY EVALUATION TEST RESULTS
FOR THE
AUTOMATIC INFORMATION TECHNOLOGY (AIT) EQUIPMENT**

June 1999

Distribution authorized to DOD personnel and DOD Contractors only; Test and Evaluation; June 1999. Other request for this document must be referred to Commander, Dahlgren Division, Naval Surface Warfare Center, Code J52, 17320 Dahlgren Road, Dahlgren, Virginia 22448-5100

Enclosure (1)

**HAZARDS OF ELECTROMAGNETIC RADIATION TO ORDNANCE (HERO)
SAFETY EVALUATION TEST RESULTS
FOR
AUTOMATED INFORMATION TECHNOLOGY (AIT) EQUIPMENT**

Ref: (a) MIL-STD-461D
(b) MIL-STD-462D
(c) Hazards of Electromagnetic Radiation to Ordnance
(HERO) Safety Evaluation Test Plan for the Automated
Information Technology (AIT) Equipment dtd March 1999

I. GENERAL:

1. During the period of 07 through 11 June 1999 Radiated Emissions (RE102) tests, as specified in the requirements and procedures delineated in references (a) and (b), were conducted on the AIT equipments being considered for use to inventory Navy ordnance. The tests were conducted as a means of evaluating the safety of using the AIT equipments in the proximity of ordnance. These tests were conducted in accordance with reference (c), which is included as attachment (1) for information purposes. The equipments evaluated were as follows:

- a. Zebra PT400 portable bar code label printer S/N 4051527.
- b. Monarch Model Number 9490 portable bar code label printer S/N 98103639.

II. TEST CONFIGURATION:

1. Since the AIT equipments subjected to RE102 tests were intended to be portable, the test configuration required by reference (b) was modified to more closely reflect the manner in which the AIT equipment would be used in the field. For example the ground plane (copper top bench) was not used for this testing.

2. For the purpose of these tests and evaluations, the input to the Zebra PT400 printer was from a Symbol PDT3500 Hand held terminal/bar code scanner. The Monarch printer received it's input from a Symbol Model LRT-3800 Hand held bar code scanner. In both cases, the hand held input devices were connected to the printers by cable, and the cable was passed through an access port in the wall of the shielded test chamber so that only emissions radiated from the printer and the interconnecting cable were measured. The test configuration of the AIT equipment tested are shown in figures 1 and 2.

3. For these tests, the Zebra PT400 was evaluated while

configured to operate on it's internal battery pack, and while configured to operate with power supplied by an external power

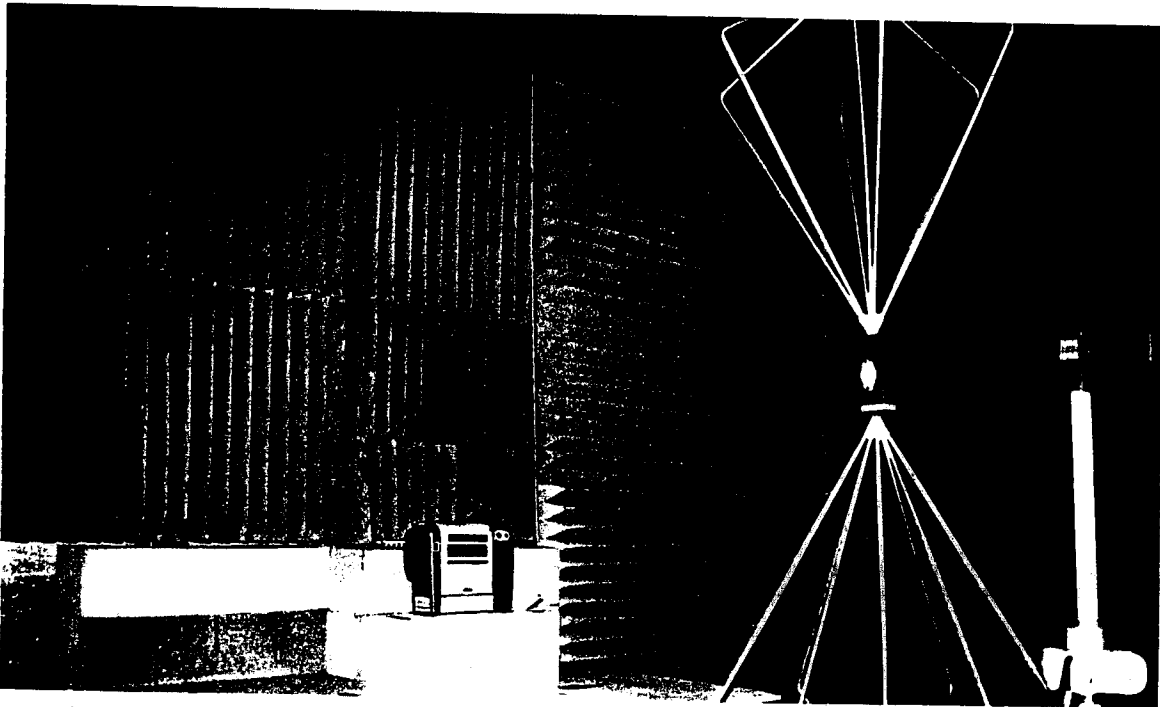


Figure 1. Zebra PT400 configured for emissions testing.

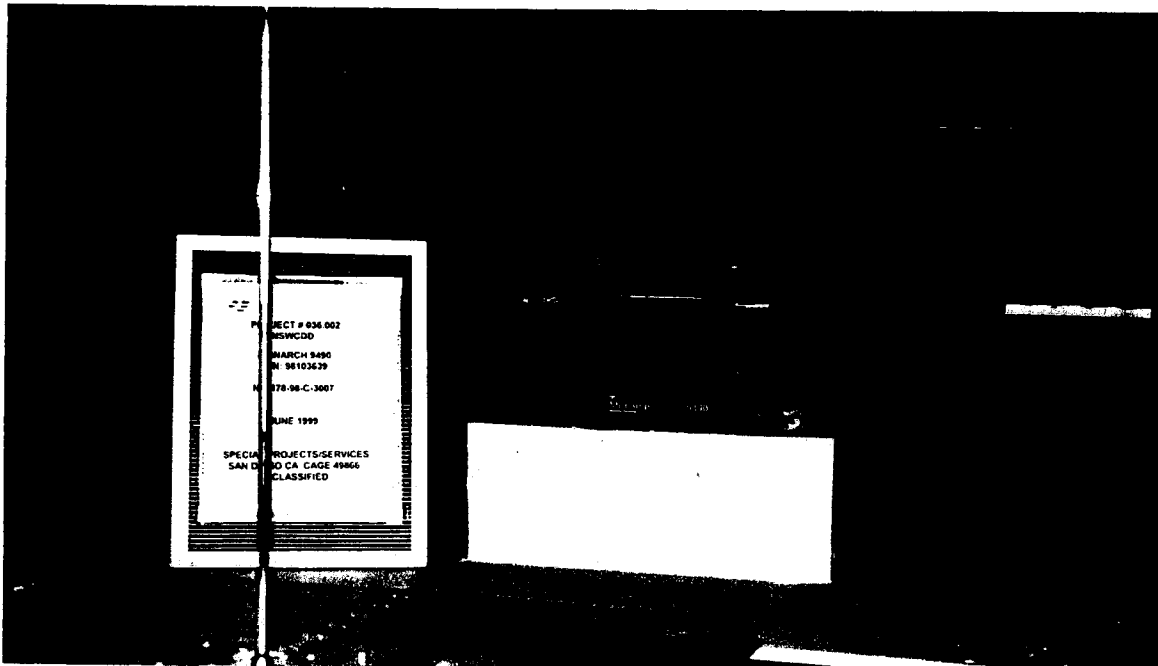


Figure 2. Monarch 9490 configured for emissions testing.

supply (Power Supply Model 54-24-1000D, 24VDC). However, the Monarch Renegade printer, which operates only on battery power, was operated from an internal battery pack during the tests.

III. TEST METHODOLOGY:

1. During the testing of both the Zebra and Monarch printers, both of the hand held terminals/scanners (the Symbol PDT 3500 and Symbol LTR 3800) were programmed to continuously scan a bar code label and send the data to the printers via the interconnecting cables.

IV. TEST RESULTS:

1. Zebra PT400 Portable Bar Code Printer, operating on internal battery: The radiated emissions from this unit exceeded the acceptable RE102 limits of reference (a) in the frequency range of 40MHz to 175MHz. The highest radiated emissions level of 60dBuV/m [or 22dBuV above the acceptable limits of reference (a)] was recorded in this frequency range at 48MHz.

2. Zebra PT400 Portable Bar Code Printer, Operating on AC power adapter: The radiated emissions from this unit, and the AC power adapter exceeded the acceptable RE102 limits of reference (a) in the frequency range of 250kHz to 200MHz. The highest radiated emissions levels of 73.3dBuV/m [or 19dBuV above the acceptable limits of reference (a)] was recorded in this frequency range at 256kHz.

3. Monarch Renegade 9490 Portable Bar Code Printer: The radiated emissions from this unit exceeded the acceptable RE102 limits of reference (a) in the frequency range of 10kHz to 175MHz. The highest radiated emissions level of 82.4dBuV/m [or 16dBuV above the acceptable limits of reference (a)] was recorded in this frequency range at 19.26kHz.

Plots of the RE102 test results are included in Attachment (2) for information purposes.

V. CONCLUSIONS:

1. The radiated emissions from all units tested exceeded the acceptable RE102 limits of reference (a) by a considerable amount. However, the maximum test current used by Electro-explosive Device (EED) manufacturers is 10mA for a 100mA EED, and the maximum current that could be induced into a 1 ohm EED by any of the units tested would be less than 4 mA assuming perfect coupling at a distance of 1 meter. Therefore, it is considered unlikely that the levels of radiated emissions measured at one meter from the units tested will have a detrimental effect on ordnance, or the electro-explosive devices (EED)s used in

ordnance. Ordnance items which are within closed metallic shipping containers will be afforded an additional margin of safety.

2. Since the RE102 test results are relatively reliable in predicting the radiated susceptibility of equipments, none of the units tested should be considered suitable for use in, either internal or external, shipboard electromagnetic environments. Furthermore, none of the units tested should be used in the proximity of other sensitive electronic equipments.

VI. RECOMMENDATIONS:

1. The following recommendations are made as a consequence of the relatively poor RE102 test results exhibited by the units:

a. The Zebra PT400 Portable Bar Code Label Printer (operating on internal battery), should not be used in the proximity to other sensitive electronic equipments. However the Zebra PT400, operating as tested, should not be considered as presenting a hazard, when operated at a distance of one meter away from HERO Unsafe or Susceptible ordnance.

b. The Zebra PT400 Portable Bar Code Label Printer (operating on external power adapter), should not be used in the proximity to other sensitive electronic equipments. However, when operated as tested, care should be exercised to maintain a separation distance of at least one meter between the Zebra PT400 and HERO Unsafe or Susceptible ordnance.

c. The Monarch Portable Bar Code Label Printer, Model Number 9490, should not be operated in the proximity to sensitive electronic equipments. Although this Monarch Printer is not considered as presenting a hazard to ordnance at a separation distance of one meter, it should not for any reason be operated at a distance of less than one meter from HERO Unsafe or Susceptible ordnance.

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RADIATED EMISSIONS (RE102-2) PLOTS
OF
ZEBRA PT400 AND MONARCH 9490 BAR CODE PRINTERS
TEST RESULTS

SP/S SAN DIEGO CAGE 49866
EMISSION LEVEL [dBuV/m] PEAK

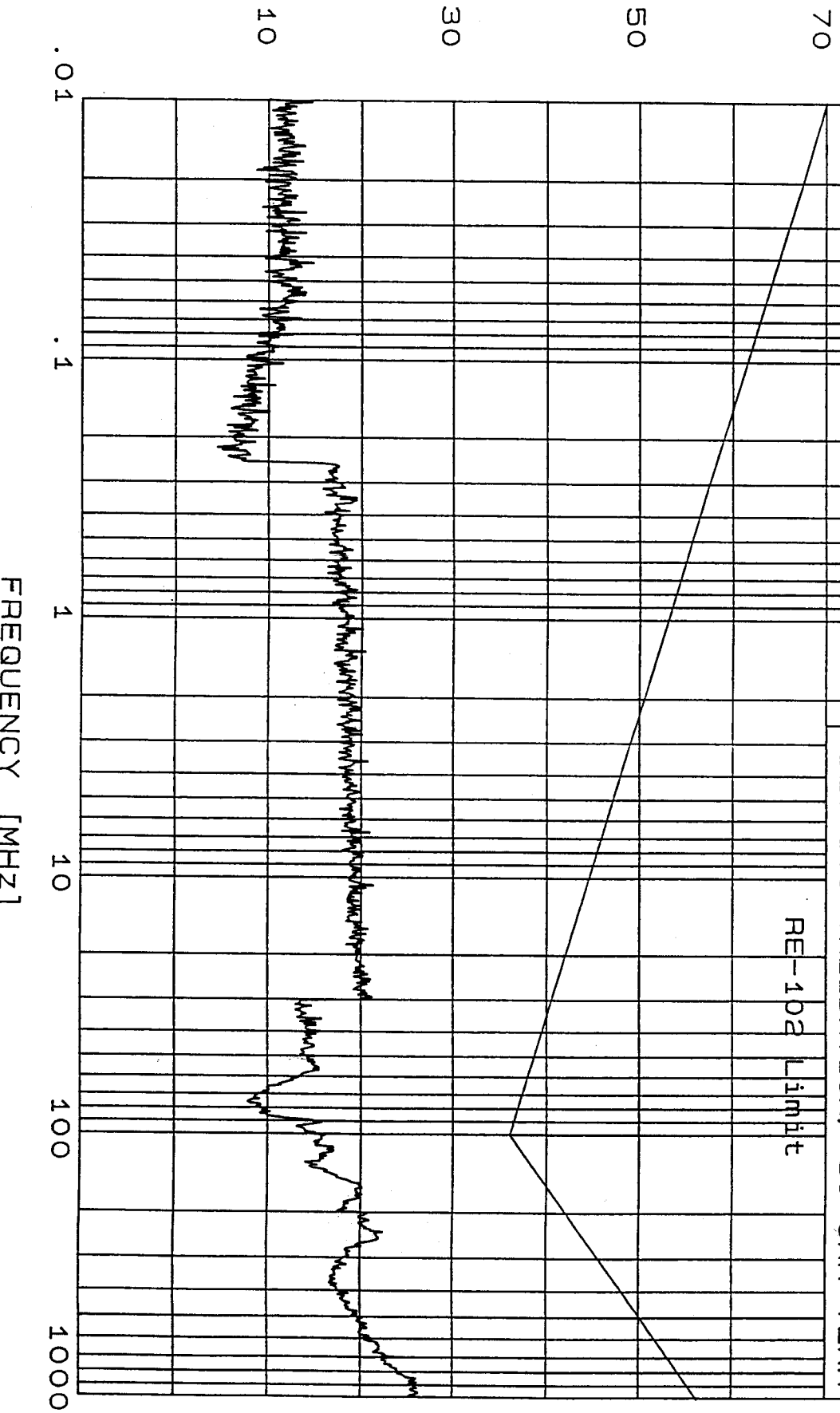
7 Jun 1999 13:10:35

hp
90

PROJECT 036.002 SPS QA NSWCDD

ZEBRA PT400 BARCODE PRINTER
SERIAL NO. 4051527
DET SYS VALIDATION/ 50 OHM TERM

RE-102 Limit



np

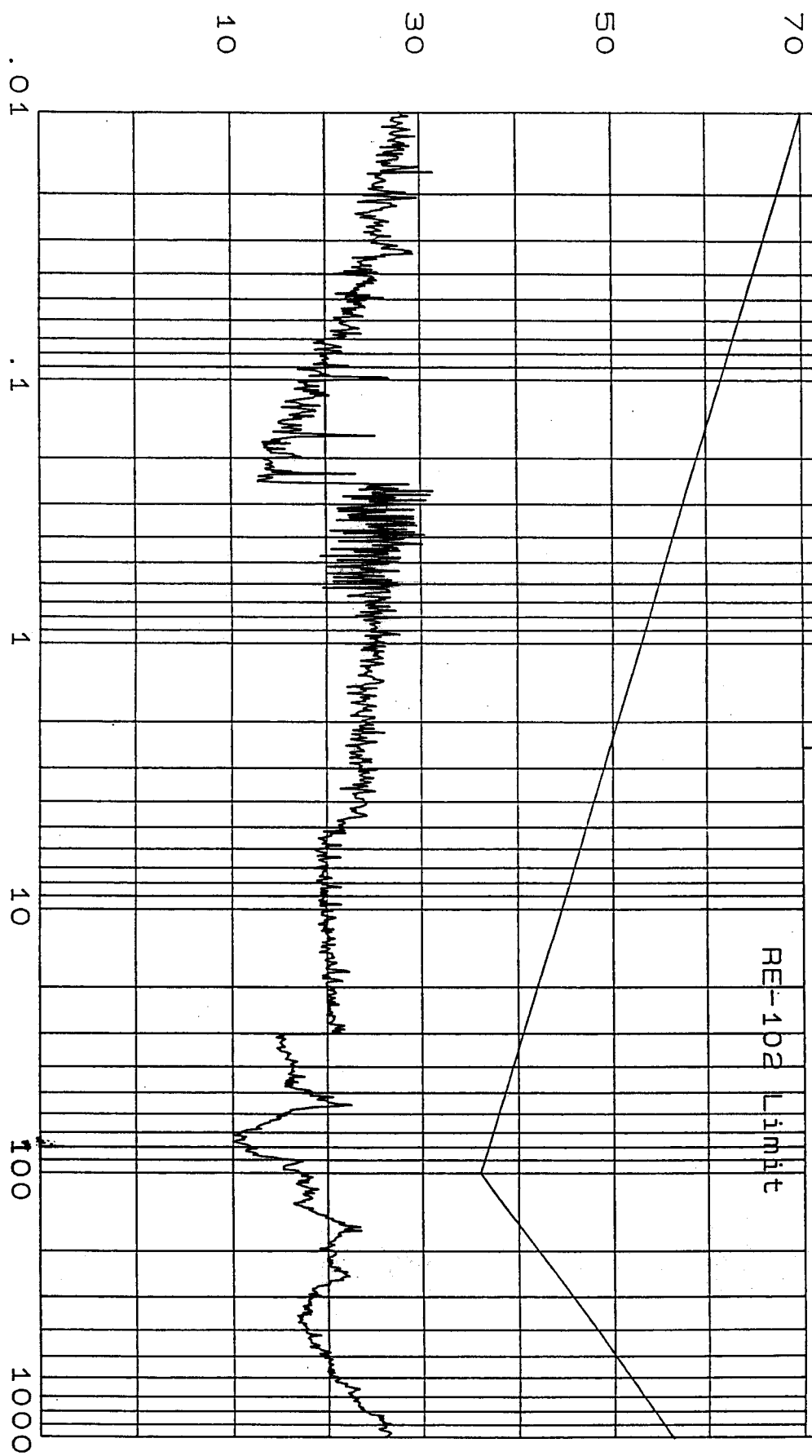
SP/S SAN DIEGO CAGE 49866
EMISSION LEVEL [dBuV/m] PEAK

7 Jun 1999 13:31:51

PROJECT 036.002 SPS QA NSWCDD

ZEBRA PT400 BARCODE PRINTER
SERIAL NO. 4051527
AMBIENT BICON HORIZ

RE-102 Limit



FREQUENCY [MHz]

hp

90

SP/S SAN DIEGO CAGE 49866
EMISSION LEVEL [dBuV/m]

PEAK

7 Jun 1999 14: 12: 32

PROJECT 036.002

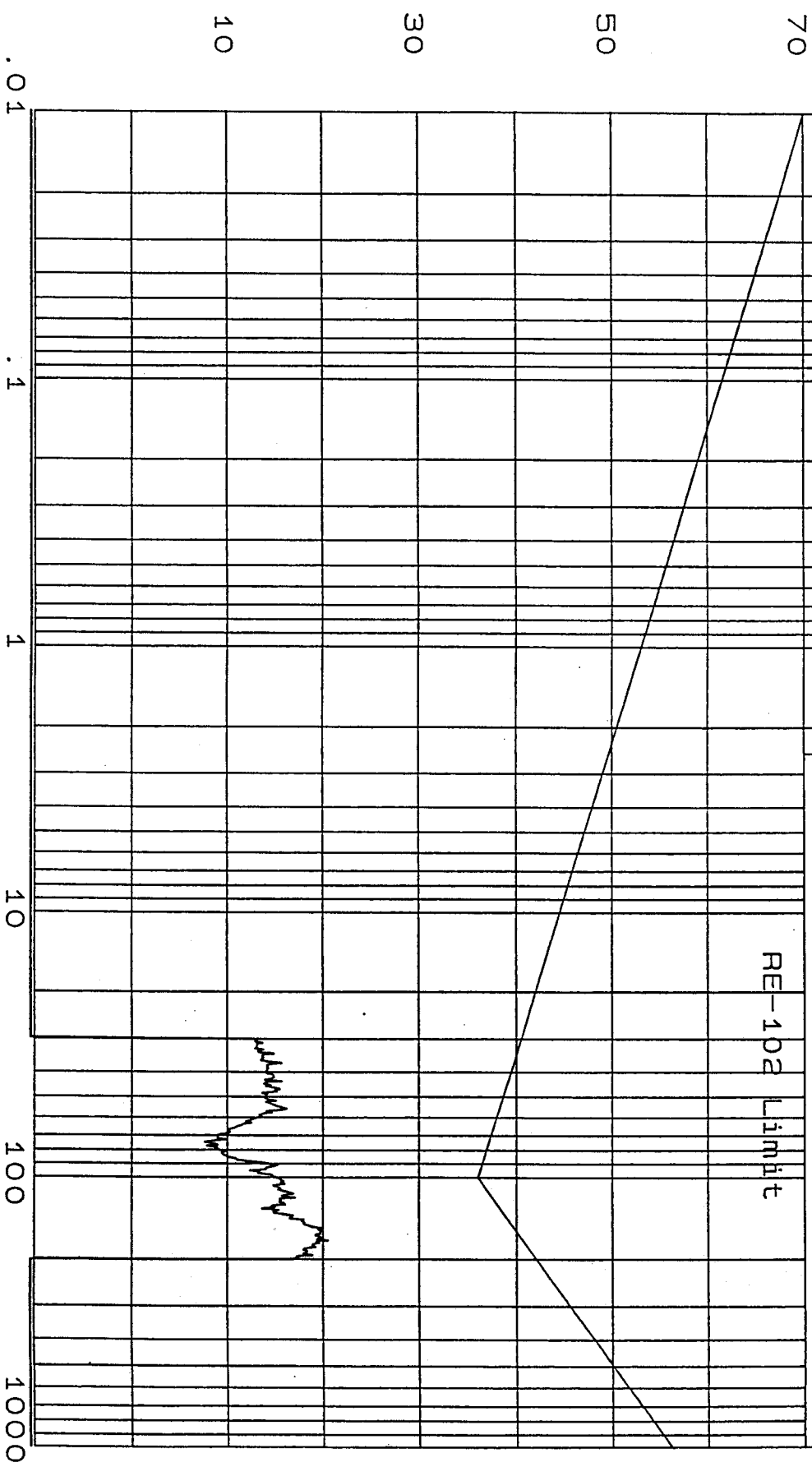
SP/S
QA

NSWCDD

ZEBRA PT400 BARCODE PRINTER
SERIAL NO. 4051527
AMBIENT

BICON VERT

RE-102 Limit



FREQUENCY [MHz]

hp

90

SP/S SAN DIEGO CAGE 49866
EMISSION LEVEL [dBuV/m]

PEAK

7 Jun 1999 14:27:02

PROJECT 036.002

SP/S
QA

NSWCDD

ZEBRA PT400 BARCODE PRINTER
SERIAL NO. 4051527
OPERATE - BATTERY BICON HORIZ

RE-102 Limit

70

50

30

10

.01

.1

1

10

100

1000

FREQUENCY [MHz]

hp

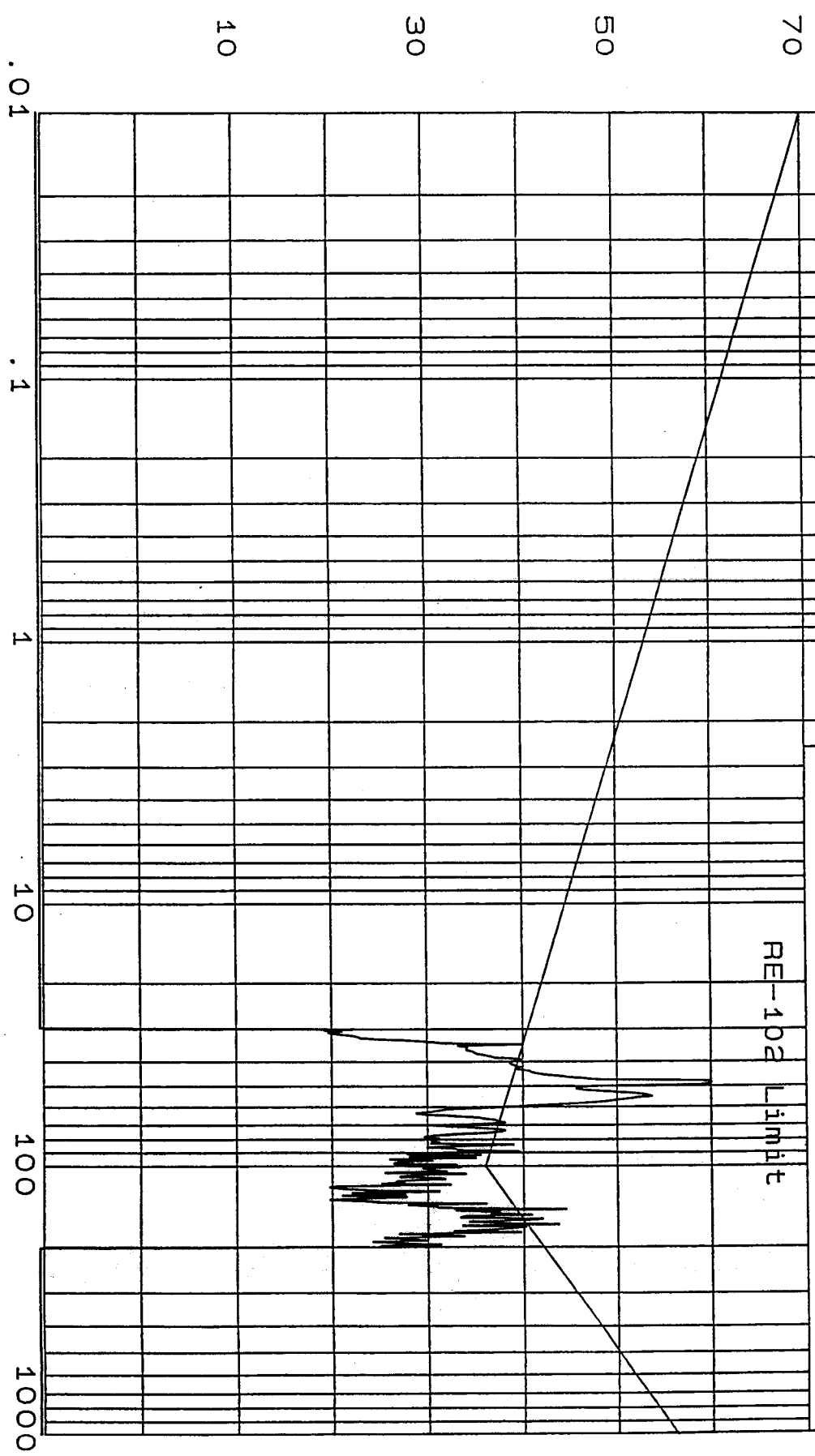
SP/S SAN DIEGO CAGE 49866
EMISSION LEVEL [dBuV/m] PEAK

7 Jun 1999 15:06:40

PROJECT 036.002 SPS QA NSWCCD

ZEBRA PT400 BARCODE PRINTER
SERIAL NO. 4051527
OPERATE - BATTERY BICON VERT

RE-102 Limit



FREQUENCY [MHz]

hp
90

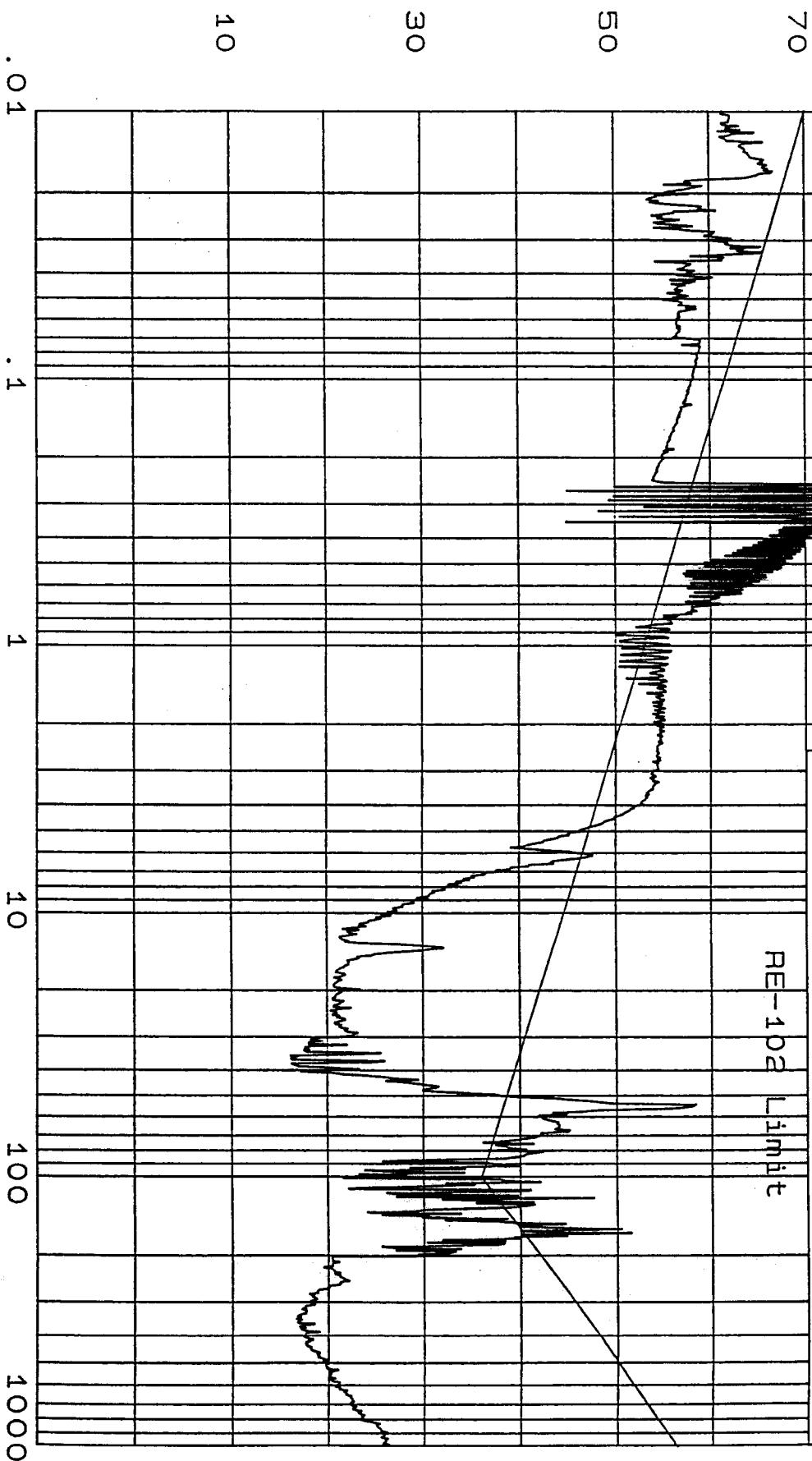
SP/S SAN DIEGO CAGE 49866
EMISSION LEVEL [dBuV/m] PEAK

7 Jun 1999 15: 37: 58

PROJECT 036.002 SP/S QA NSWCDD

ZEBRA PT400 BARCODE PRINTER
SERIAL NO. 4051527
OPERATE - AC POWER BICON HORIZ

RE-102 Limit



FREQUENCY [MHz]

hp

90

SP/S SAN DIEGO CAGE 49866
EMISSION LEVEL [dBuV/m]

PEAK

7 Jun 1999 16:12:41

PROJECT 036.002 SP/S QA NSWCDD

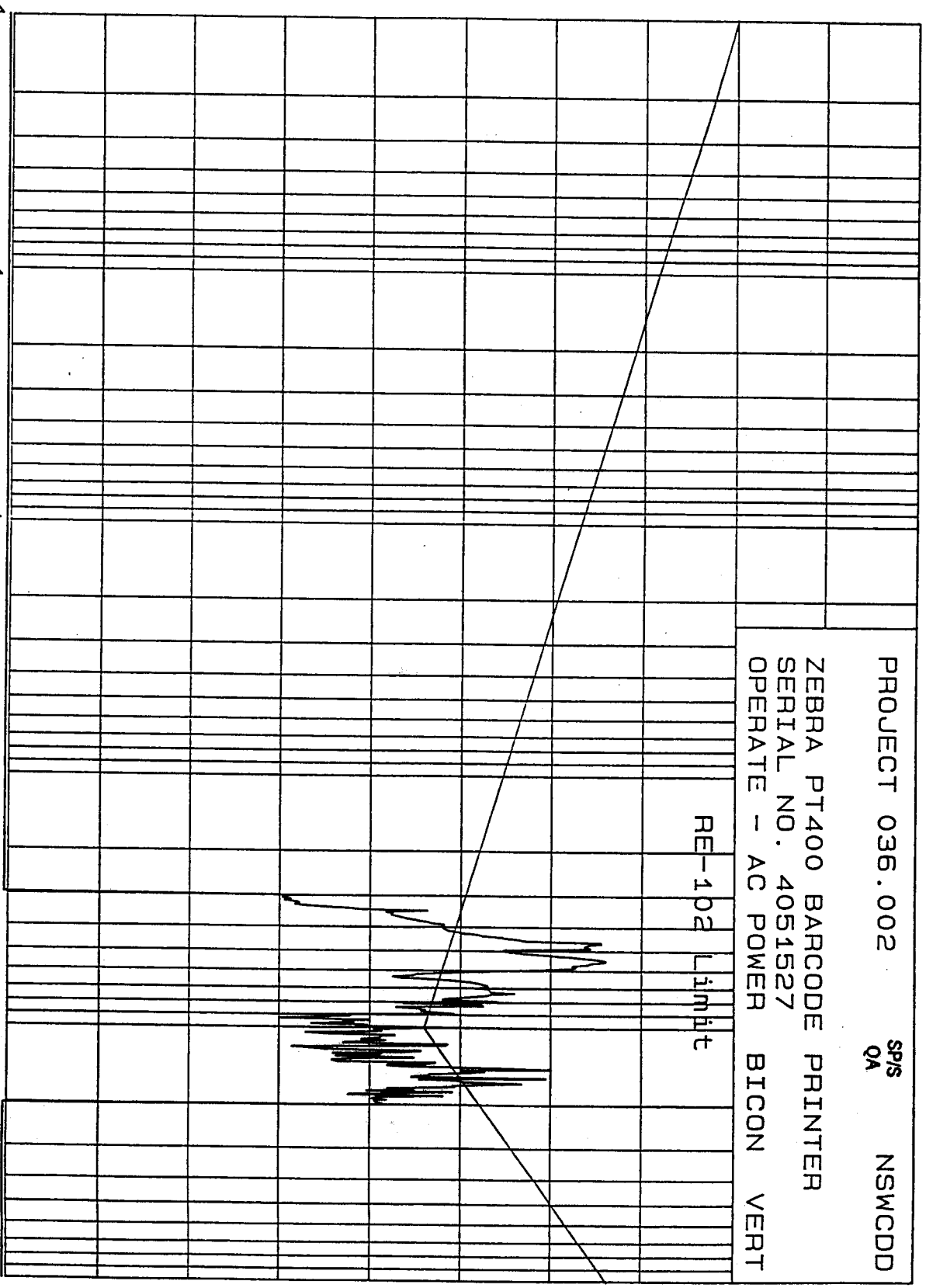
ZEBRA PT400 BARCODE PRINTER
SERIAL NO. 4051527
OPERATE - AC POWER BICON VERT

RE-102 Limit

70
50
30
10

.01
.1
1
10
100
1000

FREQUENCY [MHz]



hp
90

SP/S SAN DIEGO CAGE 49866
EMISSION LEVEL [dBuV/m]

PEAK

10 Jun 1999 12:39:01

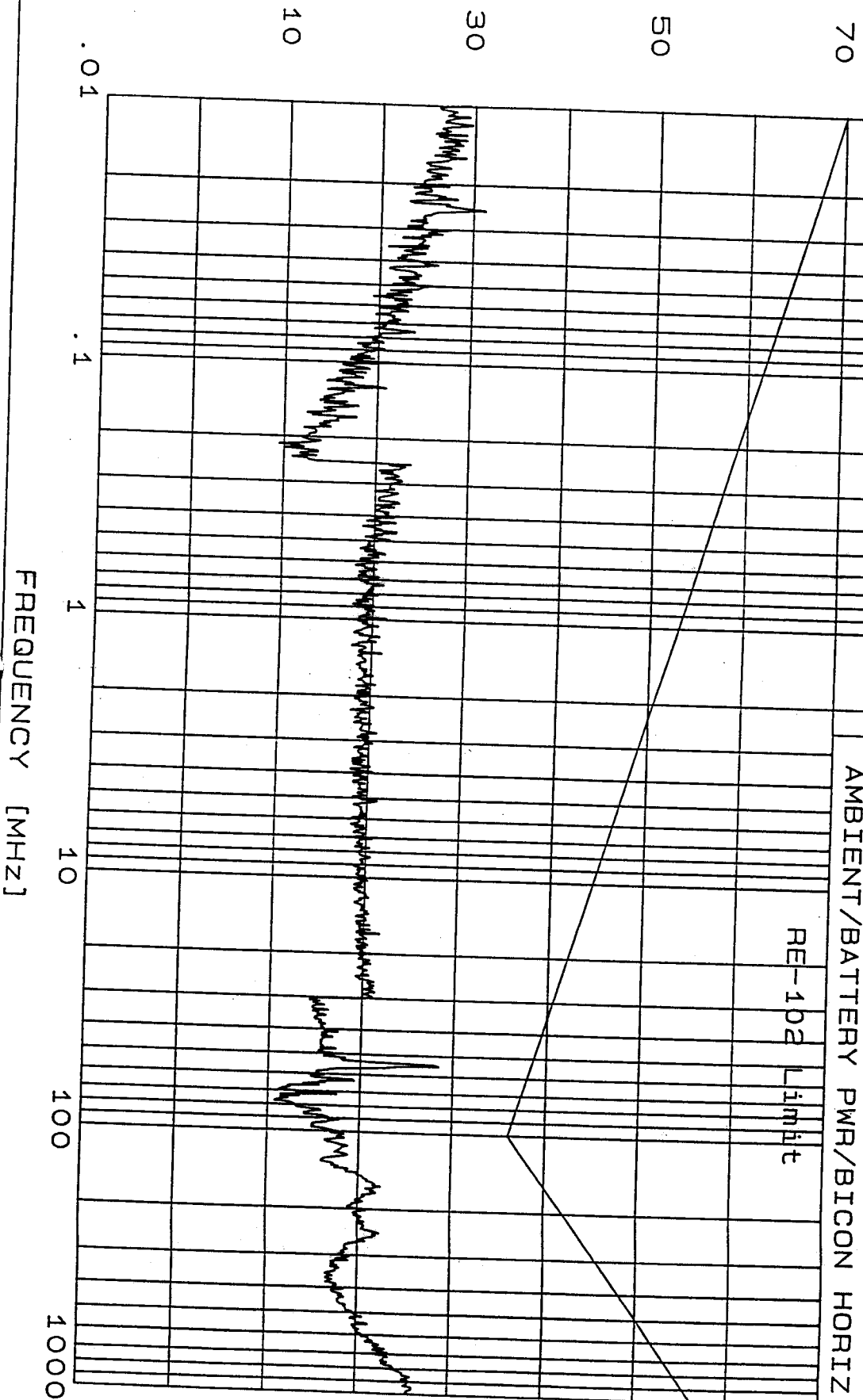
PROJECT 036.002

SPS
QA

NSWCDD

MONARCH 9490 BARCODE PRINTER
SERIAL NO. 98103639
AMBIENT/BATTERY PWR/BICON HORIZ

RE-102 Limit



7D
90

SP/S SAN DIEGO CAGE 49866
EMISSION LEVEL [dBuV/m] PEAK

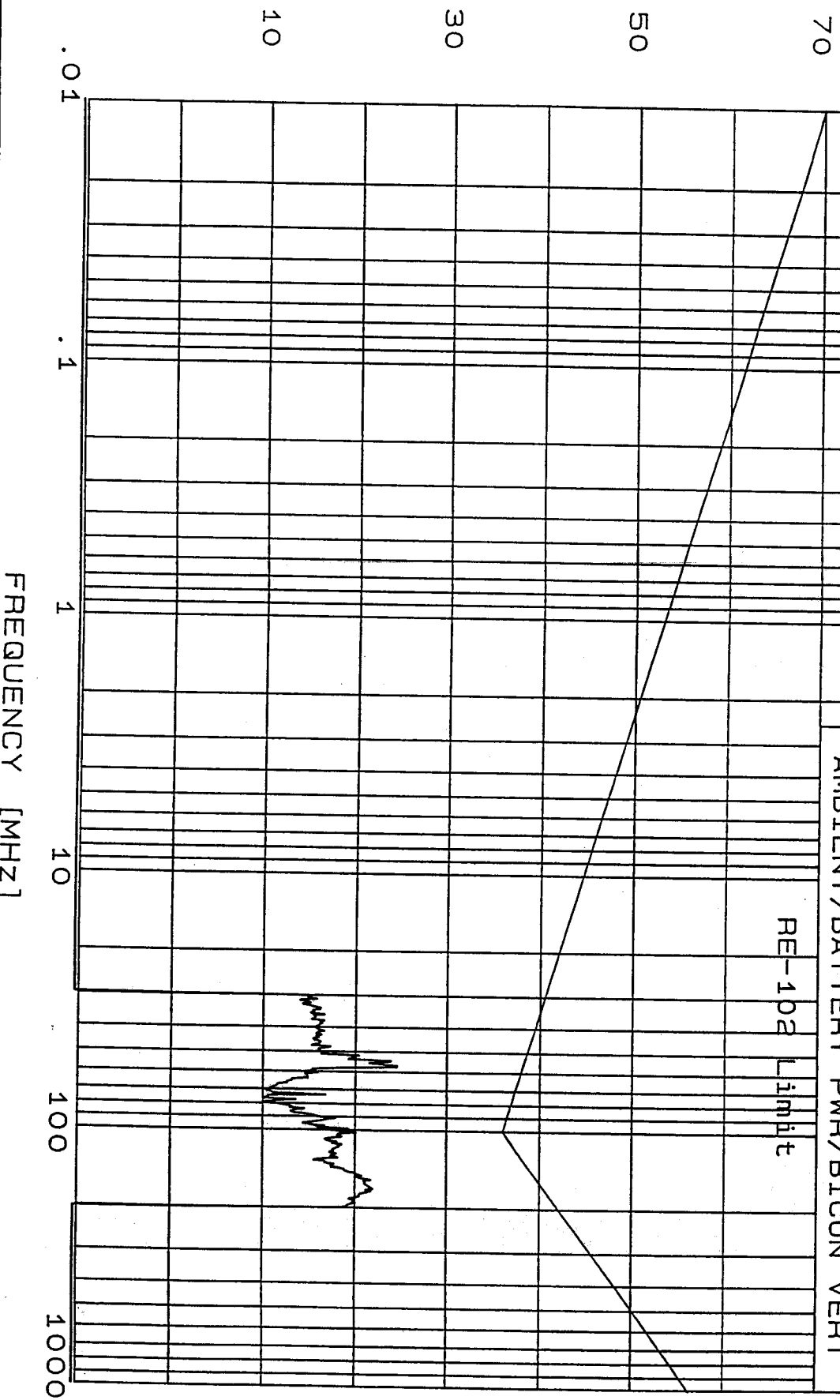
10 Jun 1999 13: 20: 58

PROJECT 036.002

NSWCDD

MONARCH 9490 BARCODE PRINTER
SERIAL NO. 98103639
AMBIENT/BATTERY PWR/BICON VERT

RE-102 Limit



FREQUENCY [MHz]

hp
90

SP/S SAN DIEGO CAGE 49866
EMISSION LEVEL [dBuV/m] PEAK

10 Jun 1999 16:25:38

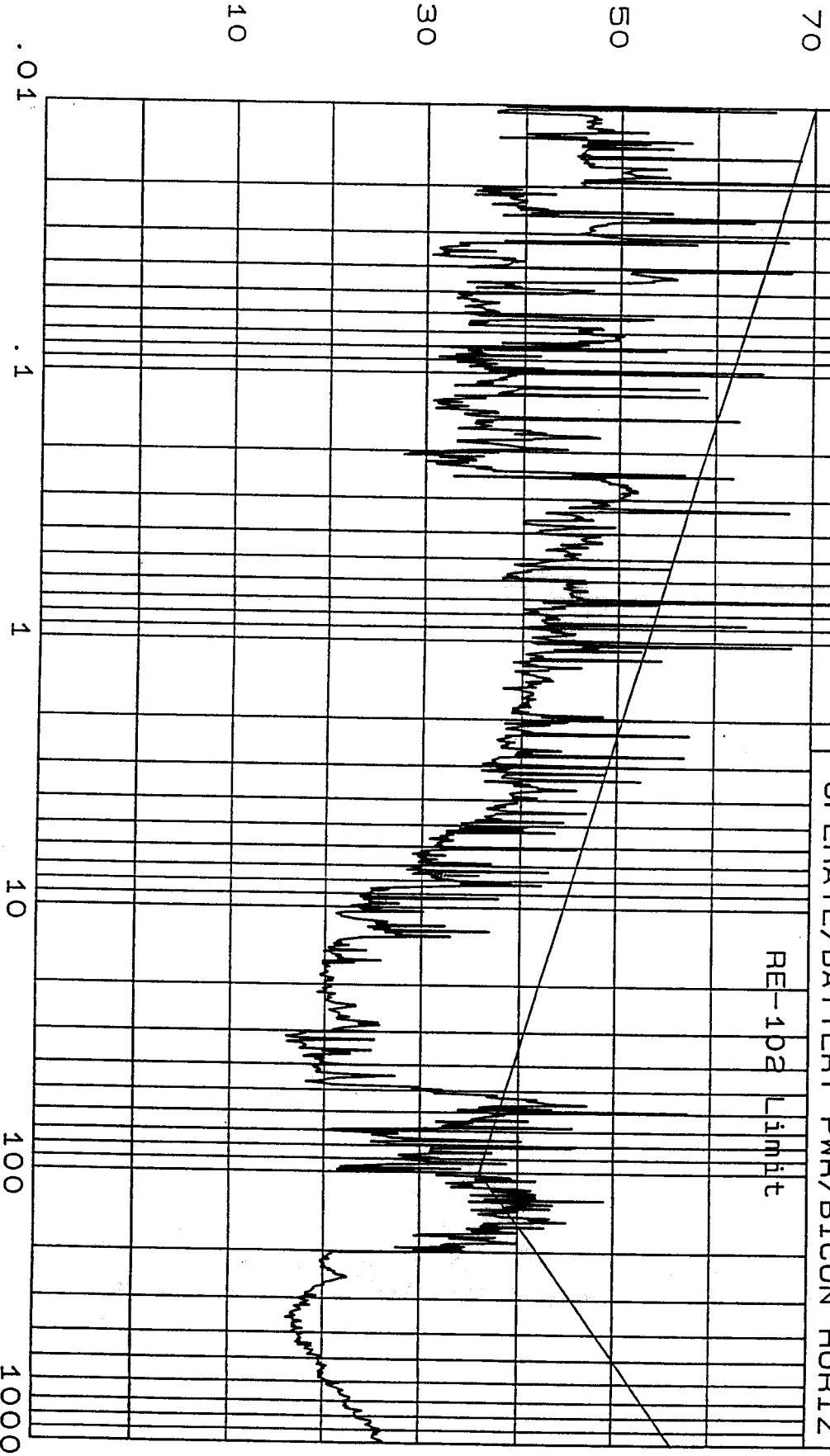
PROJECT 036.002

SP/S
QA

NSWCDD

MONARCH 9490 BARCODE PRINTER
SERIAL NO. 98103639
OPERATE/BATTERY PWR/BICON HORIZ

RE-102 Limit



FREQUENCY [MHz]

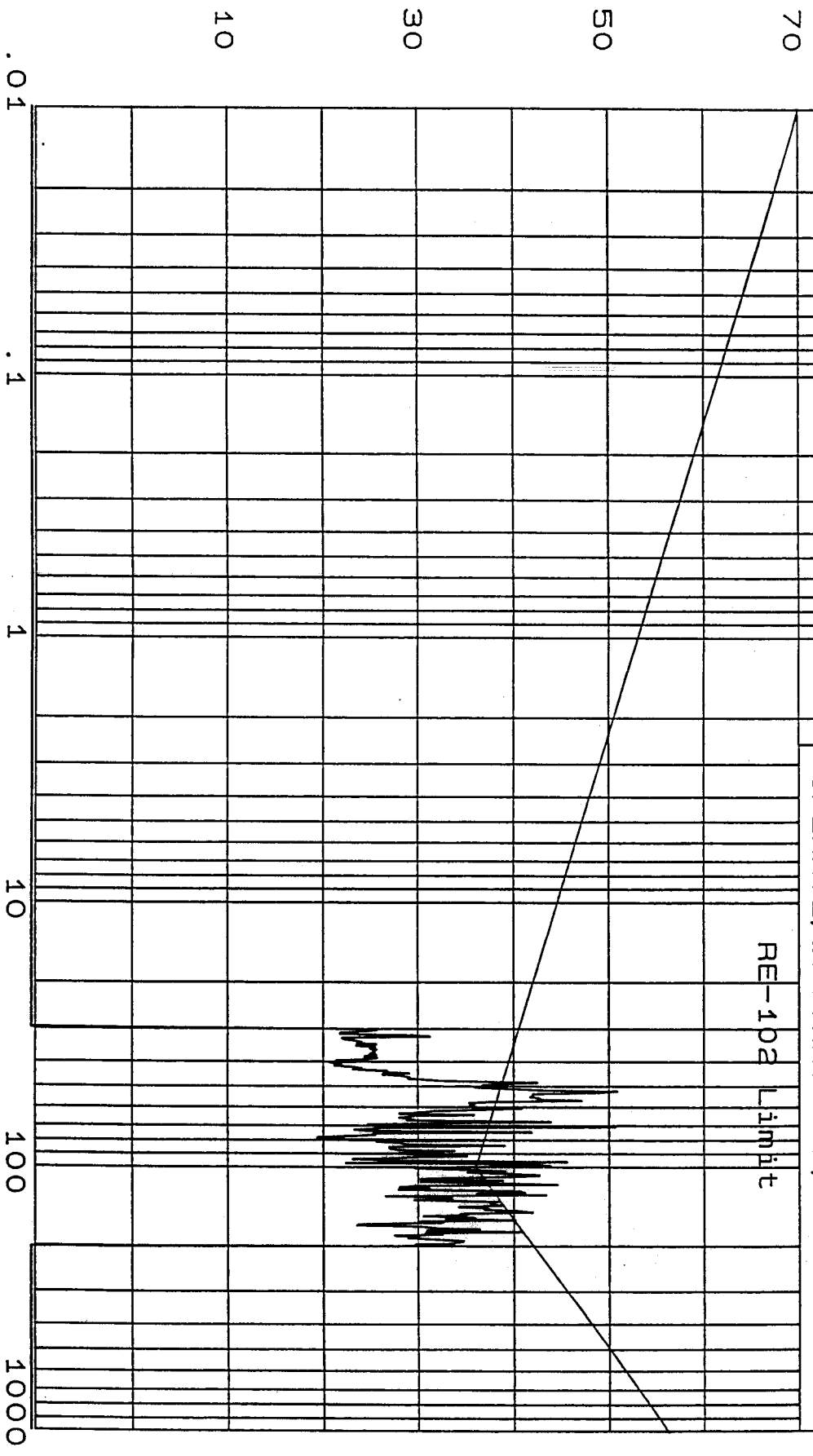
SP/S SAN DIEGO CAGE 49866
EMISSION LEVEL [dBuV/m] PEAK

10 Jun 1999 18:11:47

hp
90

PROJECT 036.002 SPS QA NSWCDD
MONARCH 9490 BARCODE PRINTER
SERIAL NO. 98103639
OPERATE/BATTERY PWR/BICON VERT

RE-102 Limit



FREQUENCY [MHz]